

## Case Report

# Upward Migration of Distal Ventriculoperitoneal Shunt Catheter into the Heart : Case Report

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Ventriculoperitoneal (VP) shunt is commonly and effectively used to treat hydrocephalus. Intracardiac migration of the shunt catheter is a rare complication. A 68-year-old woman underwent ventriculoperitoneal shunting for hydrocephalus secondary to subarachnoid hemorrhage due to anterior communicating artery aneurysm rupture. Two weeks after the shunt surgery, she had suffered from the abdominal pain. Plain chest x-rays, computed tomography, and echocardiography revealed the distal catheter which was in the right ventricle of the heart. We tried to remove the catheter through the internal jugular vein by fluoroscopic guidance. But, the distal catheter was kinked and knotted; therefore, we failed to withdraw the catheter. After then, we punctured the right femoral vein and pulled down the multi-knotted shunt catheter to the femoral vein using the snare catheter. Finally, we removed the knotted distal catheter via the femoral vein and a new distal catheter was placed into the peritoneal cavity. We report a case in which the distal catheter of the VP shunt migrated into the heart via the internal jugular vein. We emphasize the importance of careful and proper placement of the distal catheter during the tunneling procedure to prevent life-threatening complications.

**KEY WORDS :** Ventriculoperitoneal shunt · Distal catheter · Internal jugular vein · Heart · Hydrocephalus.

## INTRODUCTION

The ventriculoperitoneal (VP) shunt is one of the most common surgical procedures for communicating hydrocephalus after aneurysmal subarachnoid hemorrhage (SAH). Distal peritoneal catheter could be migrated into the unusual diverse locations. Intrathoracic migration of the distal catheter into the pleural cavity is a rare complication<sup>1,2,5,12,16</sup>. Among them, there are only several reports involving migration of the distal catheter into the heart and pulmonary artery<sup>3,4,8,10,11,13,14</sup>. We describe a case in which the distal catheter was migrated into the heart. The migrated distal catheter had been successfully withdrawn via a transfemoral incision under fluoroscopic control.

## CASE REPORT

A 68-year-old woman presented with drowsy mentality

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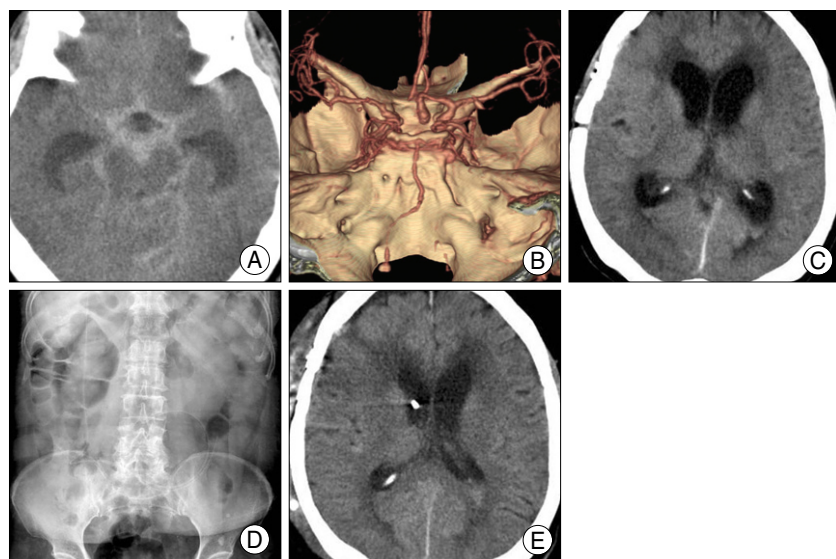
with vomiting. Computed tomography (CT) scans showed diffuse subarachnoid hemorrhage with scanty intraventricular hemorrhage (Fig. 1A), and 3-dimensional CT angiography demonstrated an aneurysm sac on the anterior communicating artery subsequently (Fig. 1B). On the day of admission, the patient underwent surgical obliteration of the aneurysm via the right pterional approach. However, she remained lethargy until five days after surgery. The follow-up non-enhanced CT scans showed the progressive enlargement of the ventricles (Fig. 1C). Ventriculoperitoneal (VP) shunt operation was performed for hydrocephalus using the low-pressure Pudenz<sup>®</sup> (Integra NeuroSciences; Plainsboro, NJ, USA) valve. The shunt tubes were easily placed subcutaneously by tunneling with an ordinary shunt passer. The 25 cm long distal catheter was introduced into the peritoneum uneventfully and postoperative simple abdominal radiography confirmed the correct catheter position (Fig. 1D). CT scan which was taken 8 days after aneurysm clipping also demonstrated the correct position of the proximal shunt catheter (Fig. 1E). After VP shunt operation, her mentality was improved to alert state gradually.

At 2 weeks after the shunt surgery, she began to complain the abdominal pain at the wound site. We were unable to

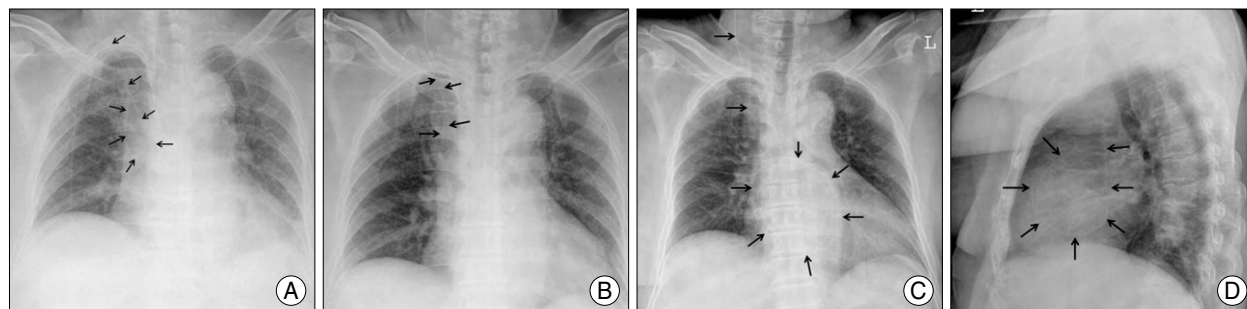
locate the distal peritoneal catheter in the peritoneal cavity. Plain chest X-rays revealed that the distal catheter was located in the heart (Fig. 2). Three-dimensional CT examination from the neck to the upper thorax showed the distal tube had passed through the right internal jugular vein,

superior vena cava, right atrium, right ventricle, right main pulmonary artery, and then reversed into the right ventricle again (Fig. 3). However, transthoracic echocardiography confirmed normal sinus rhythm and no cardiac thrombus nor valvular dysfunction.

A joint procedure with interventional cardiologist was planned for removal of migrated intracardiac catheter. On the purpose of the distal shunt catheter retrieval and diversion to the peritoneal cavity, we tried to pull out the shunt catheter by using the snaring catheter through the cervical incision under the fluoroscopic guidance. But, we could not remove the entangled distal catheter from the superior vena cava. The patient was subsequently moved to the operating room. We found the exact site of the shunt tube piercing the right internal jugular vein (Fig. 4A). After confirming the vascular puncture site, an extra-long proximal part of the distal catheter was pulled out from the heart and cut to fix the distal end of the catheter ended in the right atrium under fluoroscopic visu-



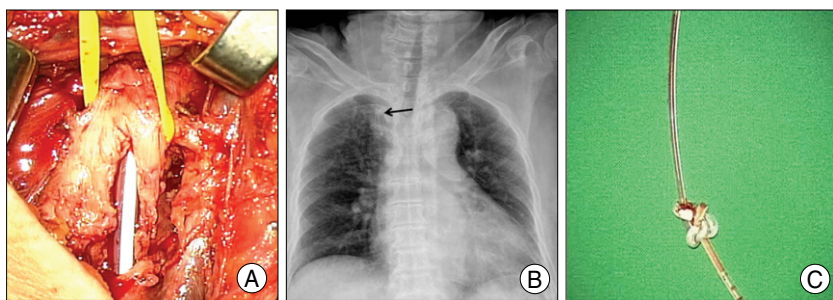
**Fig. 1.** A, B : Computed tomography (CT) scan and 3-dimensional CT angiography demonstrating ruptured saccular aneurysm on anterior communicating artery with subarachnoid hemorrhage. C : Non-enhanced axial CT scan which was taken postoperative 5 days showing development of acute hydrocephalus. D, E : CT axial scan and abdominal X-ray film taken 5 days after shunt surgery showing restoration of ventricular size and fairly well placement of abdominal catheter.



**Fig. 2.** Serial chest X-ray films demonstrating the gradual migration of distal catheter (arrows) into the heart through the right internal jugular vein from the second (A), 4th (B), and to the 12th postoperative day (C, D).



**Fig. 3.** A, B : Three-dimensional computed tomography (CT) scans of the neck & chest showing the migration of distal catheter into the heart through the right internal jugular vein (arrows). C, D : Chest CT scans showing the motion artifact, which is created by the migrated distal catheter in the heart.



**Fig. 4.** A : Photograph revealing the catheter puncture site at the right internal jugular vein. B : Chest X-ray film demonstrating the distal end of the catheter ended in the right atrium with an entangled proximal part of the catheter (arrow). C : Photograph of the removed an entangled distal catheter showing the multiple knots.

alization. As the result, the VP shunt was converted to the ventriculoatrial (VA) shunt inevitably (Fig. 4B). The next day, after first interventional procedure, her mentality was deteriorated gradually again. After confirming that shunt didn't work properly we planned the second revision of distal catheter with neuro-radiologist. Through the punctured right femoral vein, the distal end of the peritoneal catheter was picked using the snare catheter under the fluoroscope. After confirming the catheter was fastening firmly, the tube was cut at cervical site firstly. The distal catheter was pulled down to the femoral vein. We incised minimally at the puncture site of the right femoral vein and removed the entangled distal catheter completely (Fig. 4C). The proximal catheter and reservoir were connected to the new peritoneal catheter, and placed in the peritoneal cavity properly.

The patient's postoperative course was uneventful, and a postoperative plain X-rays demonstrated proper placement of the distal catheter in the peritoneum. She was discharged on fortieth day after initial admission without neurological deficit.

## DISCUSSION

Several cases of VP shunt catheter migration into the heart or pulmonary artery were reported and summarized in the literature<sup>3,4,8,10,11,13,14</sup>. This type of migration may be lethal, possibly causing pulmonary emboli, arrhythmia, sepsis, or cardiac insufficiency<sup>7,15</sup>. Therefore, periodic follow-up radiography should be scheduled after VP shunt placement. Fortunately, the present case didn't show the intracardiac complication. However, we advocated the earlier management as soon as possible after the intracardiac catheter migration was evident.

The time until distal shunt intracardiac migration diagnosed was ranged from 18 days to 4 years in reported cases<sup>3,4,8,10,11,13,14</sup>. We found incidentally that the distal

catheter migration was ended on postoperative 2 weeks. This present case showed chronologically the faster progressive migration of distal catheter into the heart than previously reported cases<sup>3,4,8,10,11,13,14</sup>. Based on the serial plane chest X-ray films, we confirmed that the tube retraction into the right internal jugular vein was initiated from the second postoperative day and completed at 12th postoperative day retrospectively (Fig. 2). But, we missed this until the patient

complained the abdominal pain. Therefore, the careful postoperative radiographic shunt survey is important. We recommend 3-dimensional CT scanning of the neck and chest in cases in which there is suspicion that the distal catheter might has migrated in the heart.

Various mechanisms have been proposed to account for shunt migration into the heart<sup>3,4,8,10,11,13,14</sup>. In our case, the peritoneal catheter was progressively drawn into the internal jugular vein possibly due to negative inspiratory pressure and venous flow. These findings can be explained with serial simple chest X-ray films and cervical intraoperative photograph. It is not enough to emphasize the importance of careful tunneling for the proper placement of distal catheter. Possible measures to minimize the chance of a similar event include using a blunt tunneling device, avoiding deep tunneling in the neck, and using a more lateral tunneling pathway along the neck and clavicle<sup>3</sup>. We did not notice subcutaneous hematoma or any signs of vessel injury during the original VP shunt operation. A neck vessel perforated by the shunt passer may be difficult to detect intraoperatively. Inadvertent cannulation of the internal jugular vein can be prevented by avoiding deep tunneling within the neck.

To remove the malpositioned shunt tube, it is not clear in any circumstance open cardiac surgery was required<sup>3</sup>. Many different percutaneous retrieval techniques have been described, including procedures with a variety of loop snare devices, grasping forceps, helical baskets, Fogarty balloon catheters, and hooked catheter guide-wire combinations<sup>6,9,17</sup>. In our case, it was very dangerous that the percutaneous removal of the distal tube because of the catheter was knotted repeatedly. Therefore, we had to remove an entangled catheter via the femoral vein. Several complications from the percutaneous intravascular foreign body retrieval include transient cardiac arrhythmia, fragmentation of the foreign body, or migration of the foreign body to a different location<sup>17</sup>.

## CONCLUSION

The internal jugular vein was perforated by the shunt passer during the creation of the distal catheter tract. Distal shunt migration into the heart is quite unusual, but could be lethal by causing pulmonary infarction, valvular dysfunction, or arrhythmia. In our case, we emphasize the importance of careful and proper placement of the distal catheter during the tunneling procedure to prevent life-threatening complications.

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